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Development of the Natural Gas Industry in California and the Building of California's First Large Natural Gas Line.

[Prepared for the JOURNAL, by MR. W. E. BARRETT.]

The early commercial development of natural gas in the State of California was first accomplished about 16 years ago, in the cities of Stockton and Sacramento, when some adventurous spirits, thoroughly American in their desires, and using the phrase generally applied to this disposition on the Pacific Coast, as "Those willing to take one gambler's chance on anything," developed a few small wells brought into existence through efforts to produce a water supply for irrigation. These wells, artesian in flow, brought from their depths varying volumes of gas, which, when tested, proved of practically the same character as the natural gas developed throughout the East and Central-Western fields. The analyses showed approximately 92 per cent. to 94 per cent. marsh gas, a trace of oxygen, about 2 per cent. carbonic acid, and from 3 per cent. to 4 per cent. nitrogen. These wells were capped with a cylindrical tank, open at one end, and sealed in the water which flowed from the well, the gas, expanding from its water confinement, being released in this vessel and conveyed by pipe line from the top to a small system of street mains and distributed for public use. This early development lead to the drilling of a number of wells directly in the cities named, and for a number of years no further research or development was undertaken.

When the Kern river fields were developed, natural gas in small quantities accompanied the artesian flow from the oil wells, which was either allowed to escape unused, or was applied to boiler firing for well drilling. These uses displayed the wanton extravagance characteristic in the development of practically all the natural resources of this country. About 10 years ago the development of oil in the Midway fields and the Buena Vista Hills district, finally led to the development of natural gas in larger quantities.

What is commonly known as "casing-head," or low pressure gas, accompanying the artesian flow of oil wells, has since been developed in small quantities in the Coalinga, Santa Maria, Sherman and Salt Lake fields, just west of Los Angeles, and in what is known as the Fullerton fields, about 25 miles southeast of Los Angeles. These latter developments have been in various quantities, but, on account of the distance from commercial markets, these have until recently been of questionable value for transmission for domestic and commercial purposes. The development in the Midway fields has been the largest of any single location in California, and, if properly conserved, will undoubtedly supply a constantly growing demand for some years. The proper conservation of a natural gas supply is a question of extremely serious moment, not only to those who have had the temerity to invest large sums of money in the development of this natural resource, but also to the many broad-minded and far-seeing men of business affairs, who have had occasion in past years to witness the most extravagant wasting of an extremely valuable and versatile fuel supply. Only in very recent years has this subject been brought noticeably or forcibly to the attention of governmental authorities of the State and Nation, in an effort to obtain necessary remedial legislation that, while conserving the interest of oil development, at the same time would reasonably protect and reserve for the future this wonderfully elastic, fluid-fuel supply. It should be handled and dispensed to the public for general service in such manner and at such rates as to preclude and prohibit the extreme carelessness customarily shown by those fortunate enough to be located in the vicinity of these resources.

As it appeared to the general public, the scheme seemed no more than the drilling of a hole in the ground and inserting therein a piece of pipe connected to other pipes. Then all that remained to be done was, with the aid of a match, to set fire to an invisible vapor issuing from various orifices to accomplish certain results in heating, lighting and cooking. And, because those in authority, perhaps unwittingly, gave little heed to the hazards encountered in the development of such a fuel supply, coupled generally with the most hazy idea of what the development of such a resource really means, either in the fixing of a rate or accepting such low rates from the promotors, they have been equally guilty of contributing to the early depletion of fields that should, under reasonable and proper regulation, have been able to meet all necessary demands for a long term of years. Instead, by various means and ever-present wastefulness, there have been destroyed, in many communities, not only thoroughly good commercial enterprises, but also the cleanest and most easily handled fuel supply yet discovered. These conditions, generally applicable to the natural gas supply the country over, are in a slight degree beginning to attract attention to the instituting of means for future preservation. There is, however, a crying need for further protection, not only in the producing fields, but to have the public educated to conserve the

supply, instead of fighting for such low rates, that natural gas will be extravagantly and wastefully used for all purposes. The effort should be to reserve this fuel for domestic purposes, together with such industrial purposes as will permit of its use in comparison with other fuels, on the same basis of work for work, as those other fuels now cost the consumer. For example, natural gas used for the production of one-horse power hour, under the best equipped and most economically supplied steam boilers, requires the combustion of from 40 to 44 cubic feet. To produce a like amount of mechanical work in an internal combustion engine, requires the use of from 9 to 11 cubic feet. In both instances, the same amount of mechanical effort or work is produced, with a difference in efficiency of something like 400 per cent. There is no question in the mind of any right thinking person that the internal combustion method should be used, rather than producing the same effort by the use of steam. In this one way the natural gas used for boiler purposes could be conserved to practically four times the current length of life. This is only one of many glaring examples; and, as a matter of fact, in-and-about the oil fields, where natural gas is used for boiler firing, the consumption will reach as high as 90 to 150 cubic feet per horse power hour.

A grave feature that concerns all persons interested in a natural gas supply, whether investors or users, is the extreme carelessness of drilling in the various fields, and the failure to exercise proper precaution of cementing or packing the casing that passes through the gas strata into the oil sands. This not only permits an early depletion of rock pressures in the gas fields, but allows gas to wander vagrantly through the soft upper stratas which have not been subjected to high compression, and it gradually wastes, through expansion into larger territory, to such an extent that it becomes an impractical proposition to accumulate and deliver it.

While these comments do not apply directly to the subject of this paper, the statements as to extravagance and wasteful users of natural gas apply directly to the California fields as at present worked, although as great care has been exercised in some instances as the skill of engineering developments dictated. There are, however, numbers of instances in the California fields, not confined to any one locality, which, in the aggregate, let many millions of cubic feet of natural gas waste directly into the atmosphere every day. If public officials would permit reasonable rates to be charged, or even the rates charged at present for artificial gas, there would be ample justification for the investment of the necessary capital to collect this present waste and convert it to public use. At the same time, the public would be receiving the benefit of this fuel at a cost equivalent to a reduction of practically 40 per cent. on what they are paying for the same service from artificial gas; in other words, equal to a supply of manufactured gas, for which the public pays 75 cents to $1 per 1,000 cubic feet, which gas has an average heating value of 600 B.T.U. per cubic foot. To obtain a given amount of heating or other mechanical work, with present appliances, requires a certain number of B.T.U. With the natural gas, having an average heating value of 1,000 B.T.U., there would be required only $\frac{6}{10}$ the quantity to produce like results as from the use of the artificial gas. This is not mere theory, but is a proven fact, in dollars and cents, when the supply of natural gas supplants the artificial. It is a sad commentary on public economy, when practically the entire commercial world, and the general public, have been expending every effort for the past 15 or 20 years to economize in the cost of manufacture and production in all lines, by employing mechanical devices, etc., and to produce the largest sum of return for the least amount of cash or effort expended. Right in the midst of some of the most progressive communities this very attempt at reduction of cost is doubtless the basis of the greatest extravagance in the use of natural resources.

Reverting again to the development and use of California natural gas. As in most similar cases this development was attended with the usual fears, both as to stability of possessions and quantity in the various fields, a condition which also applied to the development in the Buena Vista Hills or Midway fields. As an experiment, a pipe line was constructed to the city of Bakersfield, approximately 40 miles to the Southeast. The natural gas supply was turned into this community, December, 1910, and has since been supplying the steadily increasing demand. Fortunately, both for the people of Bakersfield who enjoy this supply and those who have introduced it, the price has been maintained at such figures as to prohibit the extremely wasteful uses which have resulted in the past in many communities from the introduction of a natural gas supply. It is certainly to be hoped that the various public bodies, under whose jurisdiction the production and vending of such natural resources fall, will look at the situation from the broad viewpoint of the greatest good to the greatest number, and from the viewpoint, also, of the best service and largest general use of such resource, rather than how cheap it is to be sold.

After 2 years of a continuously ample supply of natural gas had been delivered to the city of Bakersfield, men of broad minds, with the spirit of the Pioneer still throbbing in their veins, determined to increase the opportunity for enjoying the latest benefits of the great State of California by constructing pipe lines into Southern California, where several hundred thousands of the inhabitants might have the same privileges as the 20,000 at present receiving these benefits in Bakersfield. And, after a most careful study of the entire situation, the first of a series of pipe lines was constructed to the city of Los Angeles.

In one particular feature, in connection with the production of natural gas in the California fields, there is a wide difference from similar developments in other portions of the country, by reason of the entirely different geological formation. For instance, an expensive well, in the Eastern or Central-Western fields, will cost (for drilling expense) some $6,000 to $7,000, whereas some of the cheapest wells drilled in the Midway gas fields cost from $23,000 to $25,000 each, varying from such cost to as much as $55,000 or $60,000. This apparently excessive drilling expense is due to the geological formation, which, for the first several hundred feet, may seem comparatively easy work in the sinking of a well; but from this point down, the casing and cementing off of subterranean water, together with encountering from 2 to 5 stratas of boulders, and everyone who has had experience in well drilling fully realizes the difficulties which one may encounter in the setting of a string of casing.

The drilling of a successful well requires from 6 to 10 months' time, which naturally correspondingly increases the cost. When the cap rock overlying the gas strata is finally reached, at depths of from 2,300 to 2,600 feet, the rock pressures encountered reach as high as from 1,000 to 1,200 pounds, and even to pressures in excess of these figures, which have not yet been measured, by reason of the fact that, when they have been encountered, tools, mud, casing and all have been blown out, wrecking the derrick, and leaving the prospective well so bridged and filled up with gravel and shale as to make it necessary to practically drill an entirely new hole. These conditions, while not the rule, are not by any means the exception, but have occurred repeatedly. It can, therefore, readily be seen, where the well investment is from 6 to 10 times that of a like investment in other natural gas fields that have been developed, there is every reason for exercising the utmost care in the preservation of a resource which requires such an item of expense for development. Further, which is of such subtle nature that, apparently without provocation, may, through conditions apparently beyond the control of those operating, be devastated and wasted to such a point as to make an otherwise good and careful investment prove a nil factor. The various logs of the wells drilled in the Midway gas fields, while showing a comparatively uniform trend of the anticline, also reveal a wide diversity in strata conditions is necessary, in order to reach the gas sands, and, while there is a certain amount of uniformity, great phases of experimental pioneer work are also developed in each well driven.

Under these circumstances, the utmost care on the part of the drillers in this field is not only requisite, but should also warrant the most liberal co-operation on the part of those in authority, under whose jurisdiction matters of this kind are placed for care and regulation.

Before finally determining to attempt the delivery of gas to Southern California, it was necessary to ascertain whether a practical and feasible route for a pipe line could be secured. The distance by railroad was 212 miles, by wagon or automobile road, 173 miles, from Taft to Los Angeles, the former being located about 2 miles from the center of the Midway gas fields, the point where the field terminal was being in prospective location. This work of locating a route, as well as the later construction, was placed in the hands of The J G. White Engineering Corporation. Late in November, 1911, a party of three engineers, with a guide, in charge of the writer started out as a locating party. It may not be amiss to state here that San Joaquin Valley, in which the Buena Vista Hills and Midway oil fields are located, is separated from the Southern section of California by several ridges of the Coast Range mountains, reaching elevations of 4,000 to 7,000 feet above the sea level, which, by any possible route would have to be crossed. These possible crossings varied in distance, from 40 to 70 miles.

After three weeks, spent with a pack train in the mountains, a

Fig. 1.

route was finally prospected, which, when surveyed, showed that a line could be had between the objective points, making the distance approximately 112 miles; and this was eventually determined upon. The final locating surveys were completed early in January, 1912, and such filings as were necessary, by reason of the route passing through part of the Santa Barbara, U. S. Forest Reserve, were made on January 12, 1912. Immediately upon completion of this part of the work, a detail plan of organization was set up, and as the preliminary work progressed, and necessity required, the various department heads were placed and the departmental detail outlined. The orders for the pipe and principal specials were placed by the J. G. White Engineering Corporation's purchasing department, late in December, 1911, in order to take advantage of the mill conditions, and to insure early delivery. The time allotted by the client for the completion of the line was 10 months, from November 26, 1911, which meant the finishing of the line by September 26, 1912. Incidentally gas was delivered through the line on the afternoon of September 25th, one day ahead of the time and the worked completed at a net cost of approximately $1,600 under the estimate.

The preparation of the detail plans and the securing of rights-of-way progressed generally with but little delay. The line was designed to work at an initial pressure of 450 lbs., and a terminal pressure of 50 lbs., which would give a delivery capacity of 26,000 millions

Fig. 2.

cubic feet per day. The pipe ordered was plain-end steel tubing, 12¾ inches O. D., weighing nominally 33 lbs. per lineal foot. About 75 miles of this pipe was of double length, ranging from 34 feet to 40 feet in length; the balance was standard, 18 feet to 20 feet lengths, By using the double lengths of pipe, in the valleys on the north and south ends of the line, a saving of approximately $31,000 in the cost of couplings alone was effected for the benefit of the client, as the work was carried on under the J. G. White Engineering Corporation standard method of "Cost plus a fee."

As this pipe line was to work under heavy pressure, it was deemed advisable to exercise every reasonable precaution in its manufacture and preparation for shipment as well as in the construction of the line. The J. G. White Engineering Corporation furnished its own retained inspectors at the mills of the contractor tube company. The certificates of chemical composition of the ingots from which the skelp was made were at the inspectors' disposal, upon request. The inspectors principal duties were to observe the size by the ring test, the alignment of the tube, the length, weight and hydrostatic pressure test; this latter was required at 700 pounds. While the pipe was at a temperature of practically 100° F., brushed free from all mill scale, it was given a shipping coat of specially prepared protective material, allowed to dry, then shipped.

On account of the large percentage of ground salts (strongly alkaline in composition) present along the proposed route, the protection of the pipe from the destructive effects of these salts was a very necessary

Fig. 3.

precaution. For this purpose, a carefully prepared, neutralized coating was used, which had for its base a clean coal tar not a tar produced at a low temperature of say 1,600° F., to 1,800° F., but one produced at a temperature of about 2,400° to 2,600° F. There is a considerable difference even in coal tar, outside of the fact that it is black. After the pipe was received and distributed, any abrasions of the shipping coat were carefully cleaned and all dust or dirt brushed off. The spots were first coated, then the entire length given 2, 3 or 4 coats, as the analysis of the soil dictated—these analyses were made in the laboratory of the University of Southern California. After the line was completed and the pressure tests were applied, only one length was found defective, and in this length the seam ripped at 368 pounds. The line was tested to 470 pounds, for the first 43 miles from the Taft terminal; 370 pounds for the next 39 miles; and 250 pounds for the balance of the distance to the Los Angeles terminal, and, after tightening some of the asbestos joints, with which the first 10 miles of the line from the Taft terminal was laid, to the small whisper-leaks, which only developed after the line had been raised in pressure to 368 pounds, then dropped to zero, when the blowout occurred, and again raising the pressure to 470 pounds, careful inspection showed the small leaks. These leaks were apparently caused by the lack of sufficient resiliency in the gaskets to recover their original position after the high internal pressure had been applied. However, when these were once made tight under pressure they remained permanently so. The line when finally tested proved bottle tight. A second test was applied, about May 20th, 1913, after the line had laid over the wet season. A pressure of 170 pounds was then applied, from end-to-end, and it was still perfectly tight, holding this pressure 7½ hours without any drop in the gauges. All the gauges were carefully proven on two dead-weight test sets, and adjusted to perfect agreement.

Conditions of perhaps a more varied nature were encountered in the building of this line than in any similar line constructed in this country. For instance: The average haul was 26 miles from the nearest railroad points, with a maximum haul of 59 miles; water for all purposes had to be purchased by the barrel, and hauled 20 or 30 miles to the camps, and, because of its strong alkaline condition, it had to be neutralized for drinking purposes. It was necessary to construct 43 miles of mountain roads in advance of the pipe line construction in order to deliver pipe and supplies. These conditions, together with the difficulty of securing labor, where the temperatures in the desert ranged from 115° to 130° in the shade of a tent, and no other shade as far as the eye could reach, may justify the statement of the difference in conditions under which this line was built.

Labor, while not scarce, was poor and hard to keep, as one may guess, when the payrolls showed 11,794 names in 5 months, to keep a gang of about 600 men working. The rate for labor was originally $2.50 per day and eventually advanced to $3.

While the detail surveys were in course of preparation, plans and orders were gotten out for construction plant; in this, also, new features were encountered. One instance was the handling of the double length pipe. None of the standard trucks on the market could haul it, wherefore it became necessary to design a special trailer, to operate in conjunction with the motor trucks, which were used in the flat country, and one that would properly track the hind wheels of the truck and turn a corner without spilling the load. These we had built in Los Angeles, by the Moore Truck Company. They had double-bolster and side stakes, were connected to the truck with a tongue-and-toggle joint, and guided by crossed steel cable

Fig. 4.

fastened to the rear axle. The top bolster turned independently of the trailer and was fitted with small rollers, so that the load could take a lateral and unequal movement, and the trailer turn, in making a right angle turn or sharp angle in the road. This arrangement gave most excellent results. The motor truck equipment consisted of four, 5-ton and two, 3½-ton vehicles, all equipped with trailers. On the 5-ton truck and trailer, with fairly good roads, loads of 10 to 10½ tons were readily hauled, and from 7 to 8 tons on the 3½-ton outfit. With this equipment and good roads, hauling was done for a frac tion over 4 cents per ton mile. Two necessary incidents to successful truck hauling are a good repair crew and a small road gang, the latter to maintain a good road. Rough roads and a heavy load are impractical. In the mountain section, it was necessary to abandon the trucks and resort to "Texas electricity." Camp and ordinary supplies were handled with 2 single ton and 2 double ton trucks.

Water was hauled in tank wagons, except to supply the pioneer camps in the mountains, when it was hauled in milk cans lashed to a

Fig. 5.

two-wheel, "go devil," drawn by 2 or 4 mules. Fillings were made at 2 springs in the mountains, the water being piped from these for about 15 miles along the route. This was part of the pioneer work, however, and the pipe (which was 2-inch) was packed into the hills on a boro train, the slowest known means of transportation.

On account of agricultural requirements, and most of the pipe line going through private right-of-way, it was buried its entire length to a depth of 2 feet, except in crossing washes and rivers, where it was constructed on bridges. The road construction through the mountains was a feature in itself; 43 miles were constructed in 46 days. Easy grades for hauling are very essential for quick and

Fig. 6.—Hardest Pull on the Road.

economical work, and, with a few exceptions, the grade on the road does not exceed 6 per cent., and was kept as much below that as conditions permitted. The greater part of the road is notched out of the sides of the hills which are mostly a coarse granite, which made a good base with comparatively little sliding or washing in the rainy season. The average cost of road construction, including brushing trail for stringing and laying pipe, was $2,400 per mile, and covered all incidental charges. Some 70 odd tons of dynamite were used in road work. The general construction consisted of the pipe line, telephone line, terminal buildings and equipment at each end of the line, 9 patrol houses, and the permanent camp at the Taft terminal. The permanent camp consisted of a main office building (single story, bungalow type) with 2 large office rooms, 4 bedrooms and 2 baths. A wide veranda surrounded the building, inclosed with wire screen, the bedrooms opening onto it through casement windows to the floor, so that the beds could be rolled out on the sleeping porch. Four six-room-and-bath, bungalows for employees; cook house, with large mess hall and private dining room; bunk house, with 8 rooms and 2 baths; storeroom with shop; and a garage completed the camp. All buildings, except the last two, were constructed on similar lines, and provided with the screened verandas. The 9 patrol houses are of the same design, with 4 rooms and bath, light and fuel being supplied by gas from the transmission line. These cottages were roofed with

Fig. 7.

asbestos shingles, covered with asbestos siding on the outer walls, for fire protection. Each patrol house was equipped with carefully tested spring and recording pressure gauges, and telephone connecting with all other patrol stations, and the terminals and main office in Los Angeles. The telephone line was carried along as part of the general construction, with a plug station every mile; and, at times,

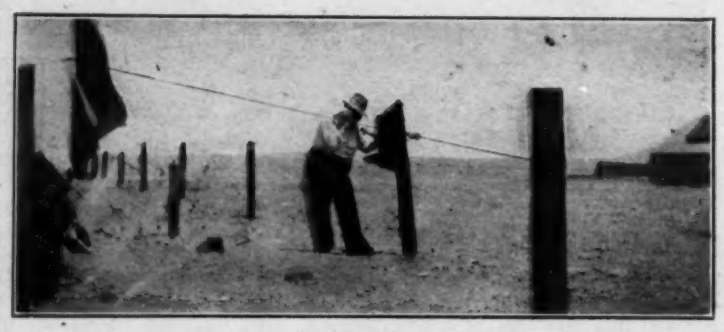

Fig. 8.

a rancher's barbed wire fence was successfully used to span a gap of several miles, as a temporary expedient.

The general outline of the construction seemed to divide itself into three natural sections; that to the South of the mountains, or the Los Angeles division; the mountain division, known as Leibre Gulch; and the desert north of the mountains or Buena Vista Hills division. The mountain division offered many interesting features. The line in this section follows, almost its entire distance, the top of the ride or hogs' back of one of the mountain ranges, at an elevation of 4,000 to 5,000 feet. This was done for the purpose of protecting the line from slides and washes during the rainy season, when it is an ordinary thing for the side of a mountain to slip and carry down thousands of yards of rock and earth. On the ridge, because there is little chance of such an occurrence, the rain quickly draining off, it was not always practicable to keep the road near the pipe line,

and in such cases the trail was brushed and the pipe snaked on wood sleds from the nearest unloading point. The ditching in this division was all hand work, and labor was hard to get and keep. The laws of California require an employer to pay transportation and one meal, when labor is transported 50 miles from a city. Five labor agencies were kept busy filling the ranks. Many times gangs of 150 men were sent from Los Angeles to Lancaster, about 70 miles, from whence they were hauled on motor trucks to the nearest camp, about 55 miles. From 1 to 6 men out of a gang might be landed in camp, the others preferring to walk or beat their way to Bakersfield (100 miles) or return to Los Angeles, the Company being out of pocket $2.90 per head. The camps, which ranged from 10 to 17, were carefully conducted, particular care being given to sanitation. Each main camp was equipped with a hospital tent, for emergency work, in charge of Internes, who were supervised by the Camp Surgeon who had charge of sanitation. These precautions were necessary on account of the employees' liability laws, and, as a result, not a single case of sickness developed on the entire work, although the ordinary runs of bruises, cuts and sprains were encountered. One peculiar accident did occur, the second case on record in California—that of a person struck by lightning. On an almost perfect sky there came an apparently innocent patch of white cloud; there was a flash, a report, and a Mexican dropped in his tracks. The only marks on the body were two black spots about the size of a quarter on the soles of the feet; but he had been instantly killed.

The hauling in the mountain division, which was done entirely with stock, became quite a transportation problem. On account of the narrow road and location of turnouts, it was necessary to time the teams and arrange as regular schedule, so that the work might be continuous and not delayed by blockades. A team boss usually went through on horseback with each train.

Fig. 9.

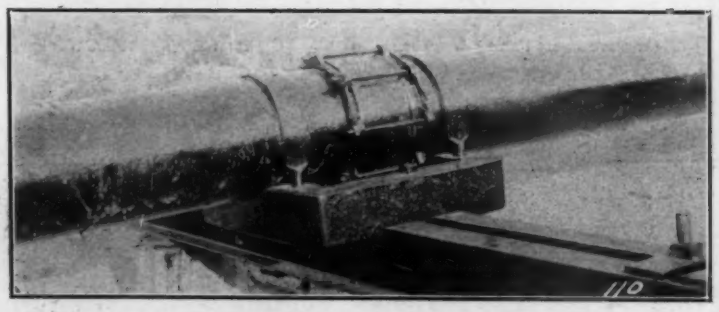

Fig. 10.

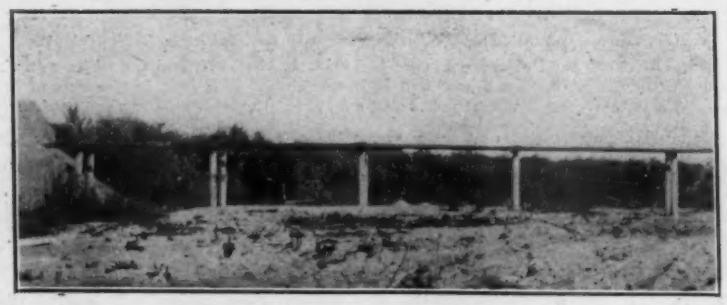

Fig. 11.

Two reinforced concrete pile bridges, 1,700 feet and 2,500 feet in length, crossing the Castaic Wash and the Santa Clara river, respectively, and a suspension bridge of about 200 feet span, were among some of the special structures.

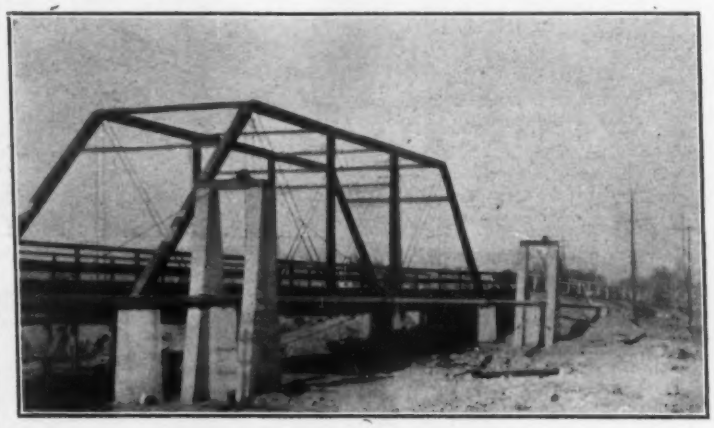

Fig. 12.

On the concrete pile bridges the line is anchored in a special cast steel saddle, fitted to the *I* beam bents. These bridges are designed to carry 3 gas lines and the State Highway. The State Highway Commission, after surveying a number of routes, determined to build the State boulevard between Los Angeles and Bakersfield, on the route taken by the Midway Gas Company's pipe line, as being the shortest and most practicable route between these county seats.

Another special feature was the Pitot tubes. The tube points were designed in the office and made up by a local instrument manufacturer, the Braun Corporation, of Los Angeles. These tubes are connected to a differential water column and a specially designed differential recording gauge. The column and recording gauge occupy a space only 6 inches by 24 inches on the wall of the station operator's office. Before these tubes were put into operation several careful tests were made at Bakersfield, using natural gas. A holder was isolated and the connection carefully sealed. During June and July a long series of observations were taken by two operators for temperatures and possible leakage. The holder was measured with extreme care and the contents calculated. It was found from the observations that, between the hours of 5 and 6 A.M., the gas, the water in the tank and the air were at practically the same temperature. Two flowmeters (of different makes) were first tested, and showed an error of 0.31 per cent. slow; the maximum error by either of the two observers was 0.42 per cent. slow. The Pitot tube for test was then connected in the line, and observations taken, the gas passing through the tube barrel, then through the flowmeter. The result showed the tubes to be very accurate, agreeing almost exactly with the flowmeter. The continuous record of the tube pressures proved a great boon to the station operators and the Company. The tube point is so made that it can be quickly adjusted when setting in either the vertical or horizontal plane, with a head-block milled to a hairline, so arranged that it could be placed in the tube barrel with mathematical precision. The terminal stations at ends of the line are arranged so that the volumetric meters may be readily tested in place, and continuously checked by the Pitot tubes.

Excavation in the valley of the Los Angeles division, and in the desert of the Buena Vista Hills division, was done principally by two endless-chain excavating machines, driven by 30-horse power gasoline motors. These machines had a speed of 5 to 8 lineal feet per minute, for a trench 22 inches wide by 3 feet 4 inches deep, according to whether soil was baked adobe or sandy loam. The dryness of the ground, and the continual cloud of dust that the machine worked in, made repairs rather expensive at times, through grit getting into bearings and moving parts, cutting them away; but on the whole they gave fairly good results. While conditions were severe at times, the work was not devoid of pleasure or occasional excitement, especially if a team of mules would take fright and go off the road with a water tank, taking all to the bottom of a canyon, a drop of about 1,500 feet. Happily only one outfit was lost in this way, the driver being fortunate enough to jump at the psychological moment. Often at night the men return to camp in the desert with a fine line of trap-door spiders or tarantulas, and after their meal would gather in various groups and, placing two spiders at a time in an empty powder can, would watch a battle royal, which usually ended in the early demise of one of the contestants, sometimes both, the contestant re-

Fig. 13.

maining alive the longest being awarded the verdict. While there was no bookmaking, there was plenty of action for all wagers. Further amusement was offered by settling differences between desert rattlesnakes, which were tied by a string to the end of a stick and encouraged till they were ready to suit action to their feelings.

When the work was finally completed and the accounts audited by certified accountants, the entire job, including surveys, rights-of-way, telephone line, pipe line, special structures, terminals, permanent camps, road, office expenses, fee and operating equipment, showed a total cost of $2.35 per lineal foot laid.

Fig. 14.

Fig. 15.

For these results due credit must be given not only to the organization, but to those able assistants: Construction Superintendent, H. M. Dougherty, and his assistants, Messrs. Robert Brisbane, R. C. Connor, and Federic Webber, upon whom depended the carrying out of the detail work; and their guidance by the J. G. White Engineering Corporation.

THE death of W. D. Marks will likely result in a revaluation of the plant (on behalf of the city authorities) of the Minneapolis Gas Light Company. And we are led to that conclusion by the remark of the City Attorney that, if the Attorneys for the Company do not consider the affidavits of Marks as admissible testimony, the city will submit that contention to the trial court. And if the affidavits are not admitted the City Attorney will ask a postponement of the case for 60 days, wherein to permit the city to secure a re-appraisal.

Shadows by Natural and Artificial Light.

[Presented at a Meeting of the Illuminating Engineering Society, London, November, 1913, by J. S. DOW and V. H. MACKINNEY.]

To show the importance of photographs of shadows consider the case of factory lighting where an inconvenient shadow might lead to spoiled work or even an accident. If, in such cases, photographs showing the shadow conditions by daylight and artificial light were taken we would have record of the causes of the mishap. There are many other instances of the importance of shadows to the illuminating engineer, especially in connection with the artificial lighting of rooms having claims to artistic and architectural distinction.

Fig. 1.

The first illustrations show the inconvenience caused by shadows of head or hand from badly placed lights, a matter appreciated by lighting experts but still not sufficiently recognized by non-technical people. Fig. 1 shows the deep shadow cast by the head of a person bending over a drawing board when the light comes from the back or overhead. The T-square and ruler, are slightly tilted to show the shadows at their edges which, although not immediately perceptible to a casual observer, cause trouble when one attempts to draw. This justifies the view that, if local lighting is used for drawing boards, the light should preferably come from in front of the draughtsman.

This is illustrated in the four photographs of Fig. 2, showing the shadows when the light is behind, and facing the worker by direct light from an unscreened lamp, and by indirect lighting. Only in the second case is an inconvenient shadow produced. It is interesting to note that an indirect fitting behind the worker does not cause a marked shadow. The difference in the sharpness of shadows is also seen in the appearance of surrounding objects. (Fig. 3.)

(a) Bare Lamp Facing Worker. (b) Bare Lamp Behind Worker.

(c) Indirect Light Facing Worker. (d) Indirect Light Behind Worker.

Fig. 2.—Note the Difference in the Shadow from the Chair and the Objects on the Wall by Direct (Bare Lamp) and Indirect Light. It is only in the Case of the Direct Light behind the Worker that a Marked Shadow is cast on the Board.

In taking the photographs the lights were arranged to give the same illumination on the table, approximating 1-foot candle, and to illustrate the depth of shadow cast by the head, the surface-brightness of the lightest and darkest portions of the paper was taken, giving the following results:

Bare Lamp. Indirect Bowl.

Fig. 3.—A General View of the Table in Fig. 2. Note the Difference in the Shadow of Chairs, under the Table and the Drawers in the Background.

System of Lighting.	Surface Brightness—Brightest Part of Board Ft.-C.	Surface Brightness—Darkest Part of Board Ft.-C.	Ratio.
Direct	1.06	0.38	1:2.8
Semi-indirect	1.06	0.5	1:2
Indirect	0.95	0.5	1:1.9

Note that notwithstanding the more distinct shadow from the direct system the numerical shadow-ratio is not very different. Yet to the eye the shadow from indirect (and semi-indirect) faded off so gradually as to be scarcely perceptible.

This, although surprising at first sight, is not unnatural when one reflects that a head near a drawing board must necessarily obstruct a considerable amount of light in any case, although different results might be obtained according to the nature of walls, height of ceiling, number of units, etc. This suggests that a satisfactory method of testing shadows should take account of the actual change in depth and also of the rate at which the shadow dies away. For this reason numerical data alone do not describe shadow conditions as successfully as a photograph.

The best plan would be to secure a good photograph and supplement it by photometric readings of surface brightness. Such photographs must be taken with care as the result might easily be falsified by slight differences in exposure and development. All the photographs here reproduced were taken by the artificial light in use at the time, and every attempt was made to reproduce as exactly as possible the impression received by the eye.

Fig. 4 shows the hand-shadow caused by light coming from the

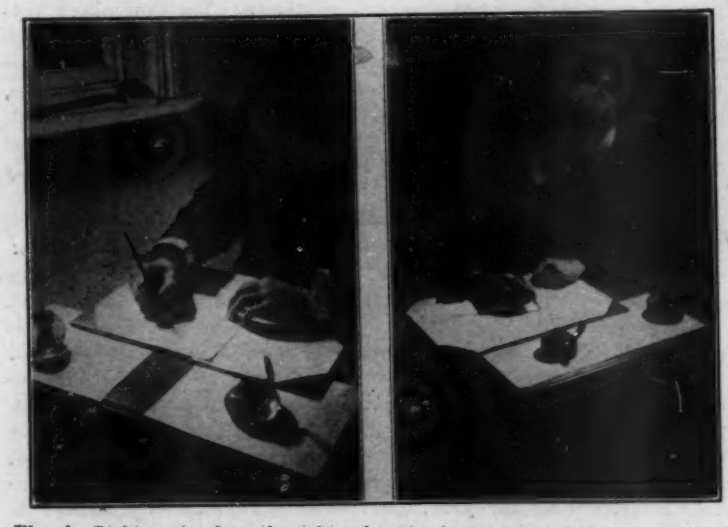

Fig. 4.—Light coming from the right and casting inconvenient shadow over writing. Light coming from the left; shadow does not fall on the writing and causes no inconvenience.

right and from the left. They justify the old rule that the light on a desk should not (if one is right-handed) come from the right.

The points illustrated in these photographs will be met with, in a more complex form, in many industrial operations, where the shadows cast by moving tools, cutting edges, etc., are highly important. A series of photographs showing the results of badly placed or imperfectly screened lamps in factory lighting would be more useful; but they deserve a separate paper.

It should be remembered that different conditions are met with when there are a number of units. With direct lighting we then get multiple shadows.

Fig. 3 illustrates the fundamental difference between the shadows by indirect lighting and by an unscreened source. One of the most striking features of indirect and semi-indirect lighting is the way in which the light gets into corners and underneath the furniture. This is shown in Fig. 5, the illumination being exceptionally high and the

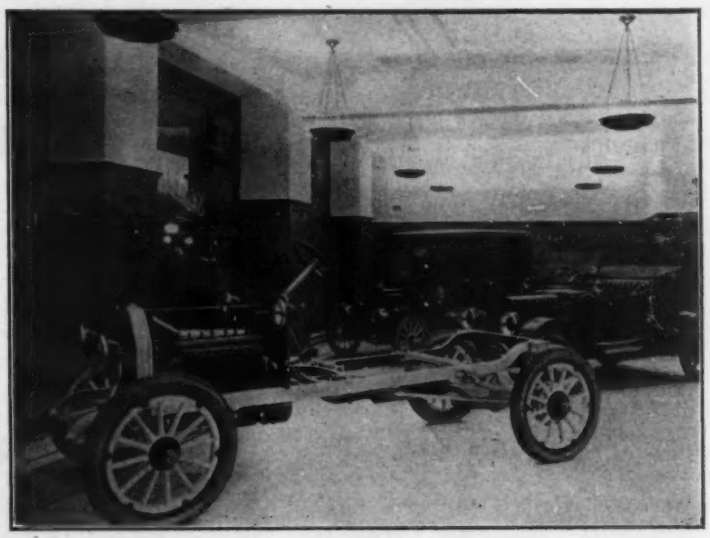

Fig. 5.

units relatively close together. The chassis in the foreground casts scarcely any shadow at all, a decided advantage where complicated machinery has to be examined. Fig. 6 is a shelf of books, illumin-

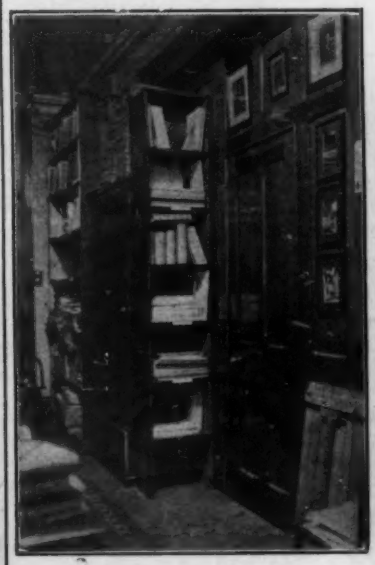

Fig. 6.

Fig. 8.

ated by direct light from a lamp in a prismatic reflector on the ceiling. Here the effect of good diffusion from the white ceiling is shown in the fact that the deep recesses are well illuminated. There is, however, a marked "cross shadow" due to the direct light. To light pigeon holes successfully good diffusion is very necessary, direct lighting by lamps in opaque reflectors immediately overhead, is of little service, as the inside of the recesses is left in dense shadow. This is one objection to the local lighting of compositors' frames which answers excellently for the type on the frame where the man is working, but is not of much help for the drawers below the level. Probably the best method of meeting this problem would be by a combination of local shaded lights over the frame with some well-diffused general illumination.

(*Continued on page* 90.)

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CHARLES H. WADELTON, Secretary and Manager.

THOMAS J. CUNNINGHAM, SANFORD K. CAMPBELL, } Editors.

NEW YORK, MONDAY, FEBRUARY 9, 1914.

[Official Notice.]

Forty-fourth Meeting, New England Association of Gas Engineers.

New England Association of Gas Engineers,
Office of the Secretary,
East Boston, Mass., Feb. 5, 1914.

The Forty-Fourth Annual Meeting of the New England Association of Gas Engineers, will be held at Young's Hotel, Boston, on Wednesday and Thursday, February 18 and 19, 1914. The meeting will be called to order *promptly* at 10 A.M. The following are to be presented:

"Notes on Vertical Settings in English Works," by C. A. Learned.

Lecture on "Ventilation," Wednesday, P.M., by Prof. S. H. Woodbridge, M. I. T.

"Chemical and Physical Properties of Lubricants," by Dr. J. F. Wing.

"Some Experience in Automobile Operation," by G. A. Smith, Jr.

Motion Pictures. "Ore, to Finished Pipe," Thursday, A.M., by F. N. Speller.

"Data on the Influence of Copper on the Corrosion of Iron and Steel," by E. R. Hamilton.

"Intensifying Output," by F. C. Crafts.

Questions for the "Box" should be sent to the Secretary as early as possible. Members will dine together Wednesday evening. Members are requested to notify the Secretary of changes in address. Please be prompt in getting to the sessions, and don't forget to bring your copies of the papers. All friends of the Association are cordially invited to attend the meeting. N. W. Gifford, Sec.

[Official Notice.]

Annual Meeting, Indiana Gas Association.

Indiana Gas Association,
Office of the Secretary,
Indianapolis, Ind., January 24, 1914.

The annual meeting of the Indiana Gas Association will be held at Terre Haute, Ind., Wednesday and Thursday, March 11th and 12th, 1914, the sessions each day beginning at 10 A.M. The headquarters will be the Terre Haute House, where 70 rooms have been reserved for the convention delegates. It is advisable that early application be made for reservations. If the available rooms are all spoken for, reservations may be made at the Filbeck, Plaza, or Great Northern Hotels. The programme includes these numbers:

Address by a Member of the Public Service Commission of Indiana.

President's Address, by A. S. Cooke, Terre Haute.

"Employers' Compensation," by O. O. Thwing, Chief Engineer, Western Gas Construction Co., Fort Wayne.

"Light and Illumination" (demonstrated), by R. F. Pierce, Manager, Illuminating Engineering Laboratories, Welsbach Company.

"Calorific Value, as Expressing the True Quality of Gas and Conditions Governing Its Supply," by J. B. Klumpp, Inspecting Engineer, United Gas Improvement Company.

"Yields of Gas from Coal as Related to British Thermal Units," by J. C. Silverthorn, Superintendent, Evansville (Ind.) Public Service Company.

The Association will consider the question of revising its Constitution and By-laws, so as to provide that any member whose dues shall remain unpaid for a term of 1 year (instead of 3 years, as at present provided), may, at the discretion of the Executive Committee, be dropped from the roll of membership. Philmer Eves, Secy.

[Official Notice.]

Time and Place, Annual Meeting, Wisconsin Gas Association.

Wisconsin Gas Association,
Office of the Treas.-Sec.,
Milwaukee, Wis., Jan, 30, 1914.

To the Members, Wisconsin Gas Association: The Executive Committee of this Association, to whomwas referred the matter of time-and-place for holding the next annual convention, decided on Milwaukee as the place, and May 13 and 14 as the date.

Yours truly, Henry Harman, Secy.

BRIEFLY TOLD.

Headquarters' Work, N. C. G. A.—That painstaking, persevering, ever-courteous, though always busy, gentleman, Mr. Louis Stotz, Secretary, the N. C. G. A., is already in the field with a summary of the work projected by this useful body for the current year. Noting that the current year begins auspiciously for the Association, Mr. Stotz declares that the many plans to be carried out during the twelvemonth will undoubtedly be of interest to every gas company, to every manufacturer of appliances, in fact, to every individual connected with the industry. Probably, however, the most important and far-reaching work undertaken will have to do with educational efforts. The "Utilization of Gas Appliances" Course was successful beyond all expectations, not only in the number of students enrolled, but by the practical manner in which the study is being conducted. There are at present 3,812 students enrolled from 162 companies, and in nearly every case the companies have formed Classes in which the lessons are thoroughly studied and discussed. That this opportunity is appreciated is best shown in the statement that 2,500 students have sent in answers to Lesson No. 1, and 1,500 to Lesson No. 2, with others coming in daily. The caliber of the answers is very high, showing that the men are getting practical information and help through their studies. The students in the Educational Classes are not all members of the Association, but it is hoped they *all* will join, to enjoy the advantages incident to such membership. Gas company employees will find that affiliation with such an active Association offers many opportunities. The "Monthly Bulletin," which will be of far greater value this year, is alone worth the price of membership. The latter, too, gives an individual a certain standing among his fellow employees, opening a field of usefulness and activity of which he might well take advantage of. While not much has been said, since the December Convention, about the Association's plan for a National advertising campaign, that should not be taken as an indication that interest has lagged. Important developments are underway and a most active campaign will be started to enlist the support of every gas company and appliance manufacturer in subscribing to the general fund. The 1914 National Advertising Committee is composed of Messrs. C. W. Hare (Chairman), Thomas R. Elcock, Jr., E. N. Wrightington and A. P. Ewing.

Pledges assuring $55,000 have been signed, and it will not be long now before something positive will be started. The Committee having in hand the preparation of the proposed booklet on "Gas Equipment of the Home" has been working diligently to complete it. The work is intended as a ready reference vehicle for owners of homes, as to the most up-to-date gas equipment for lighting, cooking, heating, etc. After the Revision Committee has finally passed on the copy, the book will be published and offered for sale at practically cost. The Board of Directors held two meetings this year. All committees have been appointed and the Exhibition Committee (of which Mr. L. F. Blyler, Minneapolis, will be the active head), is now making preparations for the annual convention next December. Our Minneapolis friends are looking forward to a large attendance, and expect to have one of the largest and best exhibitions of appliances ever held in the country. Plans are being laid to have a mid-year conference of gas men. The idea is to have this more or less informal, a two-day meeting, part of the time to be given to Committee meetings, and part to an open discussion of topics not generally brought out at the annual gatherings. A few papers on subjects not usually brought forward will be read and discussed. The idea is to keep alive, during the year, the interest which usually reaches its height at the annual conventions. The Association is growing rapidly in numbers and in its activities, which means its usefulness to the industry is increasing each year, but there is much yet to be done, and every effort will be made to accomplish something each year which will reflect credit upon the industry and the Association. Co-operation is the keynote of the Association's work to-day.

MEETING, THE NEW JERSEY PUBLIC SERVICE SECTION, N. C. G. A.—The New Jersey Public Service Section, N. C. G. A., held its meeting for January in the Assembly Room, Public Service Building, Broad and Bank streets, Newark, N. J., the evening of the 27th ult.. The formal organization of the Public Service Section was perfected, and the election for officers resulted as follows:

Chairman—William H. Pettes.
First Vice Chairman—Col. W. H. Rogers.
Sscond Vice Chairman—W. Greacen, Jr.
Treasurer and Secretary—O. F. Potter.

The officers briefly acknowledged the confidence of their fellows, and asked for co-operation to enable them to keep the organization to effectiveness. Other routine business having been taken care of, the balance of the evening was given over to a well-diversified entertainment, Mr. J. Zingg acting as Master of Ceremonies. While the Essex orchestra was tuning up for the first number, pipes and tobacco were put in service. The Assembly Room was crowded to its capacity, nearly (if not quite) 400 being present. While it is hardly proper to make especial mention of any particular act (these numbered 14), it is nevertheless a fact that Hunt and Kearney, in their "Black and White Sketch," were uproariously funny, and the North Hudson Quartette (Messrs. Miskam, Adams, Schmidt and Menzer) were especially tuneful. It may also be written down that "Ed." A. Mueller had the time of his life while accompanying on the piano the wonderful whistling act of Cashier E. A. Work. Again, should anyone desire to secure an artist in "dialect offerings," application should be made to Hartman, of Newark.

CURRENT MENTION.—

IN the damage suit for $50,000, brought against the Economic Gas Company, of Los Angeles, Cal., by a Mrs. Binney, the jury found for defendant. Complainant averred that her health had been permanently injured through inhaling gas fumes from imperfectly maintained gas fixtures, and the defendant maintained that there was no cause for action in that the city was responsible through neglect to properly inspect fixtures installed by plaintiff—an ordinance to such effect is on the statute books—and the jury so held.

AT the annual meeting the Portland (Me.) Gas Light Company the following Directors were elected: Wm. H. Moulton, George H. Vail, Fred. N. Dow, H. G. Beyer, H. Payson and W. W. Thomas. The Directors subsequently perfected the following organization: President, F. N. Dow; Vice-President, Wm. H. Moulton; Treasurer and Clerk, Burton Smart.

THE Birmingham (Ala.) Railway, Light and Power Company is proposing to use by-product oven gas from the ovens of the Tennessee Coal, Iron and Railroad at the latter's coke oven plant in Fairfield. As the present standard of value prescribed by the Birmingham authorities is based on candle power, the ordinance will have to be amended to suit the proposed changed conditions.

AT a recent meeting of the Borough Council, National Park, N. J., a franchise to maintain a gas supply in the Borough was awarded to the projectors of the Fort Mercer Gas Company.

MR. ROBERT J. LONG, since 1889 Superintendent of the U. S. Military Academy gas works, West Point, N. Y., died at his home in West Point, the evening of Monday last. Mr. Long, who had been connected with the Salem (Mass.) works, left there to assume charge of the West Point plant 25 years ago, and accomplished much in its maintaining, despite the indifference of the authorities to that particular branch of industry on the reservation. He had been ill from Brights' disease for some time. He was in his 64th year, and is survived by his wife and one daughter.

IN connection with the appointment of Mr. R. R. Young as State Agent, Gas Division, the Public Service Corporation, New Jersey, Mr. C. H. French succeeds to the position of New Business Manager, the Essex Division, and Mr. H. D. Gillingham assumes charge of the Corporation's trading in Newark. Mr. Henry Wells has been appointed Agent of the South Essex division, and Mr. George Wilson, heretofore Chief Clerk at Paterson, becomes Agent there. Of course, these are only a few of the changes recently operative; and it would appear that the "step-up" plan was followed all through the promotions.

AT the annual meeting of the Winsted (Conn.) Gas Company these officers were chosen: Directors: F. M. Travis, Henry Skinner, E. R. Holmes, H. L. Roberts, J. M. Travis, Edward Clarke, L. R. Griswold, F. B. Parsons and H. M. Tanner; President and Manager, Henry Skinner; Treasurer, J. M. Travis; Secretary, F. M. Travis.

MR. J. E. MONTGOMERY, who has been acting as Superintendent of the gas division of the Birmingham (Ala.) Railway, Light and Power Company, since the resignation of Mr. K. L. Simmons last December, has been formally appointed to the succession. Mr. Montgomery has been with the Company since 1906.

THE Kalamazoo (Mich.) Gas Company is putting up an addition to its office building on Rose street, in which the meter repair department and storeroom will find suitable housing.

MR. ARTHUR C. COBB, formerly with the Gardner (Mass.) Gas, Fuel and Light Company, has been appointed Sales' Agent to the Worcester Suburban Electric Company, with headquarters in Uxbridge, Mass.

MR. R. J. LOGAN, who was connected with the selling division, Anderson (Ind.) branch of the Central Indiana Gas Company, for something over a year, has taken over, for operation on personal account, the gas appliance shop formerly maintained by the Central Company in Anderson. Prior to his going to Anderson Mr. Logan was on the sales' force of the Fort Wayne (Ind.) Gas Company.

MR. E. A. WAKEMAN, General Manager, the Wilkes-Barre (Pa.) Gas Company, has announced that this gas rate schedule will obtain, from the first prox.:

Monthly Consumption. Cubic Feet.	Gross, Per 1,000.	Net, Per 1,000.
First 1,000	$1.10	$1.00
Next 2,000	1.10	.90
Next 20,000	1.10	.80
All over 50,000	1.10	.70

To obtain the net, accounts must be settled within 10 days from date of rendering.

MR. C. A. ERWIN, of Winters, Cal., and associates have applied to the authorities of Vacaville, Solano County, for the right to there construct and operate a gas plant. Vacaville is the collecting and distributing point for one of the most prolific fruit growing districts in the world. And, wonderful to relate, the district was virtually a desert 25 years ago.

ON the third prox. the qualified electors of St. Petersburg, Fla., will vote on the proposition to authorize an issue of bonds in $148,000, the proceeds of said issue to go to the construction of a gas plant to be operated on municipal account. It is provided in the ordinance that each 5 years, from the commencement of actual gas sales, a total of $25,000 will be called. The balance (or $48,000) will then be called in two sums, $24,000 during a period of 20 years; or $2,400 per annum. Our informant adds: "There is no doubt whatever that the vote will favor the issue. Meanwhile, I may repeat that the J. B. McCrary Company (Atlanta, Ga.) is preparing plans and specifications for the work."

A COMPLETE patent has been issued to Mr. A. S. B. Little, of Nashville, Tenn., for his well-known patent, "Little Grids," for use in purifying boxes. It is claimed by Mr. Little's Patent Attorney, who presumably should be an authority in the premises, that a "record," in so far as lapse of time is concerned, was established in securing the issuance of these Letters Patent.

THE women folks of Cordele, Ga., are still working positively over the prodding of the City Council, to bring the latter to the point of at once granting a franchise for the construction and operation of a gas plant in Cordele. The Chamber of Commerce is also busying itself over the project.

THE Public Utilities Commission, of Idaho, has declared that public service corporations, requiring their patrons to deposit a certain sum guaranteeing that accounts for service shall be paid, must allow such patrons as interest a sum equal to 8 per cent. per annum on the face of such deposits.

"B. L.," writing from Tacoma, Wash., under date of the 27th ult., says: "Just a line or two in which to say that the Tacoma Gas Educational Club last week held the second of a series of dancing parties. The floor was set in the Palm Academy, and 100 couples had a merry time. As you know, the Club is composed of the Company's employees, and its formation has resulted in benefit to the latter and in value to the former. The business sessions have been largely attended, and we are surely indebted to the splendid co-operation of the officials of the Company for the success attained."

THE Commissioner of Public Safety, Syracuse (Mr. P. W. Hitchcock), is considering the advisability of terminating the tenure of life of the local Bureau of Gas and Electricity. In respect of his attitude in the matter the Commissioner remarks: "There has been no superintendent of gas and electricity since last April; and, so far as I have been able to discover, there has been no complaint about the service to the Bureau. Nor have any recommendations been made. The annual up-keep of the Bureau amounts to $5,200.

(Continued from page 87.)

(a) Misty daylight. **Fig. 7.** (b) Artificial light.

Fig. 7 is intended to show the characteristic difference between daylight and night illumination in the street. The photograph on the right was taken on a misty day with a white sky. The head, being bent down, is in partial shadow; there is nothing like the contrast in the left hand view, where half the face is brightly lighted and the remainder in dense darkness. Note the shadows from the legs of the tripod cast by the street lamp, which do not occur by daylight. Here again there is need of a series of photographs showing the shadow conditions of methods of street lighting. In the streets, as in large halls, it is difficult to produce an impression of bright illumination even by very powerful lamps. For the effectiveness of the lighting is limited by the little assistance derived through reflection from surroundings. Experience shows that an object has to be illuminated from many different directions to be properly distinguished. In the street, with powerful units at considerable intervals, this can rarely be the case, and in some instances the dense shadows cast by moving vehicles are very misleading to pedestrians.

Having shown the value of well-diffused illumination, let us now turn to a case in which light from all directions is what we do *not* require. Fig. 8 is a photograph of an inclined board, lighted by a lamp in an opaque reflector, used by printers when examining the "lay-off" sheet. When the trial sheet is removed from the machine it is necessary to examine closely the impression of the type in order to ensure that the pressure is just right. The printers therefore examine the reverse side, and the marks on the paper here displayed indicate where changes are required.

In order to show up these irregularities in the surface one requires a light striking the paper obliquely. In the illustration the impression of the type most remote from the source (and therefore lighted most obliquely) is clearly seen; but near the source where the rays strike at angles nearer to the vertical one cannot see the projections nearly so well.

To a person reading a book in the ordinary way, light striking the paper at a small angle of incidence is most convenient, and very oblique rays, which show defects, are objectionable.

In examining fine worsted, or cloth, the same reasoning might apply. The expert in examining such materials is guided very largely by small irregularities in their surface, and these can best be displayed by oblique rays from a source of small dimensions, and therefore casting fairly marked shadows. Depressions in a piece of quilting or knitted work would presumably show up better thus than if the light struck the material from all directions. Perhaps, too, this would apply to cloth having a complex pattern in different materials, such as shot or broché silk, or velveteen, the appearance of which varies much according to the angle from which it is illuminated.

It seems that most people engaged in such operations as knitting and sewing prefer a strong local light—possibly because they can then examine small differences in texture by moving the material and so altering the incidence of the light.

The illustrations shown next might form a starting place for further experiments. The small box was illuminated in two ways; by direct light with black surroundings; by indirect light with white surroundings. By this means one gets a contrast as regards shadow, much greater than usually met in practice. In Fig. 9 the difference in shadow-conditions is illustrated by means of the small shallow

Fig. 9.—Showing Sharp Shadow on the Left, Soft Shadow on the Right thrown by "Shadow Tester."

tester described by one of the authors in a paper before the Society early this year. In Fig. 10 some silver is shown. The difference

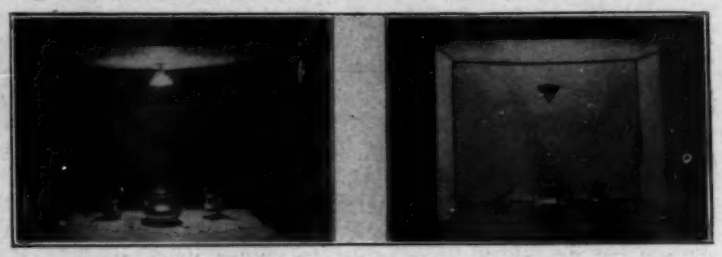

Fig. 10.—Note difference in Shadow underneath the Silver, and the "Reversa Effect" in General Appearance, some of the dark parts on the left appearing bright in the Right Hand View.

here is not so marked, the chief distinction being the much deeper shadow under the object by direct light. But it seems possible, especially with more distinct lights, that indirect lighting might not be so good for highly polished objects as direct or semi-indirect. For to show off such goods one relies upon the sparkle produced by reflected images of lights in their surface. The photographs hardly illustrate completely the distinction in this respect, for there is a tendency for the bright points of light to be over exposed—a condition hard to avoid if the exposure is to show the background satisfactorily.

Fig. 11 shows some selected samples of cloth. The hanging strip

Fig. 11.—Showing the Value of Oblique Direct Light in bringing out Broche Silk and Velveteen Patterns and Showing the folds in Material.

Daylight. **Fig. 12.** Night Time.

in the centre is brown velveteen, the two side pieces broche silk, and that in the foreground an ordinary camera cloth. The folds of the cloth and the pattern are decidedly more distinct with direct lighting; light coming from all possible directions seems to obliterate to

Fig. 13.—Photo. by Daylight.

Fig. 14.—Photo. by Artificial Light.]

some extent glossy patterns on a mat ground, and most patterns that depend upon difference in the degree of "matness."

The problem when to use diffused illumination, and when unidirectional light, also occurs in connection with the general lighting of interiors. For example it is not definitely settled what variety of shadow is best adapted to show statuary, carving, etc. A special instance is the white embossed friezes the details of which, when illuminated by light coming from all directions, are not so well marked as if lighted by oblique light, but it is sometimes contended that the effects produced by the latter method although more pronounced are unnatural.

Fig. 12 showing the front of White's Club by daylight and by artificial light is an instance of the value of oblique rays in showing up mouldings. The artificial lighting of the face of the building was from two lines of concealed lamps in trough reflectors. Note that the mouldings stand out in much stronger relief and are more noticeable by night than by day.

Figs. 13 and 14 are an example of another characteristic difference between natural and artificial illumination, showing the "reversal of shadow" by artificial light. In the daylight view the pillars stand out white against a dark background, while with the artificial light we get an opposite effect, due to the lamps behind the pillars. The arch on the right shows similarly, the interior being brighter than the front surface during the day, but darker by night. Here again some assert that these shadow reversals are unnatural and should be avoided. Yet it must be conceded that the concealed lights shown in Fig. 14 have a charming effect, and it might be urged that the artificial lighting of architectural features is a new field. It is necessary to imitate the effects characteristic of daylight, and as artificial lighting is radically different from daylight in its distribution and arrangement it seems unreasonable to force it to give the same shadows.

Some of these architectural points are worthy of special discussion. Indeed, the more one examines and considers these matters, the more he is struck by the important part played by shadow in almost all problems of artificial lighting.

As to Those Who Handle Public Utilities.

[Prepared for the JOURNAL, by E. DE MARSH.]

What is a public utility business, and what does the successful management of such a business imply? A public utility business is one which renders service of practical value to a greater or less number of individuals or corporations, such as the furnishing of light, heat or power for use by private citizens, municipalities and corporate firms.

Naturally, the consumer demands the maximum of service, at the minimum of cost, and if he does not get it he is going to be dissatisfied. The public service manager has it in his power to make such changes as will yield the most profit to his stock and bondholders, or, being prohibited from doing this, he may so reduce production and distribution costs as to accomplish the same end, but to him who does this the hour of retribution will surely come. The policy which considers only the present is too short-sighted a one for him who hopes, not alone to maintain but to increase his business. Not only must the business produce, but the revenues of that business must be wisely and economically expended.

What kind of a man should be at the head of the public utility business? One who can furnish, in sufficient quantities, a product the best of its kind, who is well informed and capable, a good judge of human nature, who knows how to select and retain efficient help, is wideawake and up-to-date, well informed as to his competitor's plans and operations, unfailing in tact and courtesy, who will treat company patrons fairly and honorably, and who is big enough and broad enough to sink personalities in the common good. Lesser men aspire to such positions, even attain them, only, sooner or later, to give way to better and stronger than themselves.

No super-sensitive man should attempt the work, neither one hasty-tempered nor impatient. Poise, dignity, geniality, keen observation and insight, ready wit and wisdom, are indispensable. To the man who does not possess these qualifications I would say, either make them yours before you aspire or direct your energies elsewhere.

Never antagonize a man, if you can possibly avoid it. What you gain will be more than offset by the harm he can do. Satisfied patrons are good advertisements for any business; to the public service corporations they are an absolute necessity.

Patience, too, is an important factor of successful management, to which anyone who has ever been connected with a gas business can testify. Pleasant, sensible people are often honest in the maintaining of quite absurd statements and beliefs regarding gas making and distribution; and often, after wearing out the clerks, will demand an interview with the manager. If they are good patrons and worth retaining, it is wisdom on his part to receive them. How he meets them to explain away the apparent error or discrepancy, or admit the justice of their claim with promises of satisfaction or restitution, makes his value to the concern which he represents. Between the manager and his subordinates must exist a feeling of kindness, courtesy, mutual interest and harmony. In proportion as your employee recognizes your ability and force of character will he be dependable and work with you. Feeling that you are interested in him, he will lose no opportunity of carrying out your wishes as he would his own. The man who says "Our company," "Our business," and means it, is the one you want and must have. The feeling should be spontaneous, and only he who is wise and kind and just, who loves his work and is intensely interested in it, can inspire such feeling.

Needless to say, capable men of long experience are as valuable in a public utility business as elsewhere; perhaps more so. Young, inexperienced clerks should never be placed at the complaint counter, on the telephone or as tellers. If you must have them, let their work be remote from direct contact with people whom they may dissatisfy or antagonize by inattention, pertness, or lack of knowledge and judgment.

An important item for every manager to consider is satisfying the demands of his stockholders and board of directors in their wish for "The best service for the least money." Results are what they are after, likewise, dividends; and yet, poor machinery, inefficient or insufficient help, will not accomplish the desired end. Competent and experienced workers are requisite, and while there should be no more employees than actually necessary, the necessity for economy must never hamper the efficiency of the service.

Up-to-date and skilful competition is something every head of a business must meet, and especially is this true of the gas business. In a certain sense, gas and electricity are inter-related, are con-competitive; in another sense, however, they are not. The obtaining and retaining of patrons in either field require certain methods peculiar to the business. Fortunate is he who starts with a well-satisfied lot of consumers; yet, good judgment, tact, and business-like methods will go far to bring excellent results, even from bad conditions.

Only insofar as it stimulates to effort is competition good; and it costs. The judicious manager is he who can minimize it, neither ignoring nor giving it undue prominence. If your competitor has something good, make your own equal to, or an improvement upon, it; but never, through the attention bestowed upon his wares, advertise them.

Good lieutenants, and heads of departments, are other indispensable elements of business success. Having chosen your men and outlined your policy, leave to them the details of carrying forward the work. Make the head of each department a manager in embryo. At frequent intervals, require clear, concise reports, and from personal observation know what each is doing. Let the departments work out that which you want done, and have not time to do; but exact from one and all the same kindness, courtesy, tact, and judgment in dealing with both employees and patrons as expected from you.

In planning extensions and improvements to the business, do not lose track of the multitude, various and many, of expenses to be met, such as construction, distribution, depreciation, insurance, salaries and wages, collections, interest on bonded indebtedness and dividends. After these have all been provided for, then you may improve or extend as much as you deem necessary, and as your board thinks advisable.

Some people imagine gas is practically all air and aroma, and that the profits of the business are enormous. This is not true, inasmuch as large capital must be invested in plants, and contingencies must frequently be met. He who can reduce costs without deteriorating the value of the product will find a sure road to promotion. The wise man pools his interests, and thus purchases materials and supplies at a considerable saving. Likewise, he utilizes all by-products to the fullest extent, and, if he carries light, heat and fuel appliances, he will be sure that neither an over supply nor an under stock confronts him. Also, he will see to it that his appliances are artistic, up-to-date, and reasonable in price. No "deadwood" will be allowed to accumulate, since by frequent special "sales" he will dispose of stock which does not move readily.

The public utility business must be a success financially; yet that is not enough. It should be so conducted as to please the most exacting patron. Not only are stockholders and directors to be satisfied, but customers must be allowed no reasonable ground for complaint. Many times people look through a dark glass in dealing with a public corporation. Sometimes they have just cause for this; more often, not. Infinite tact, judgment and large measure of self-control, should be called into play in dealing with the angry or dissatisfied consumer; and of inestimable value is he who can listen patiently, explaining clearly and logically, treating the complaining patron in such manner as to win confidence and goodwill. Do not assume that he is dishonest, no matter how absurd or offensive his remarks may be. He likely believes he is in the right, and it is for you to show him why he is not; or, if he be right, to see that the matter is properly adjusted. The very life of your organization depends on public favor, and personality is an important factor in directing and satisfying the general public.

In conclusion, let me say, successful management demands great executive ability, coupled with strong commonsense, a broad outlook, subtle powers of analysis, familiarity with the business, a pleasing personality, ready adaptability, wide acquaintance with human nature, ability to cover quickly all phases of a subject, firmness without arbitrariness, the power not only to set the machinery going, but the ability to know when it is going right. In short, the more the business manager knows, and the wiser he is in the use of this knowledge, the greater will be his value to the business over which he presides.

English Practice with Welded Joints.[1]

Though steel gas mains have been in general use for about 10 years, lead jointing was continued until 2 years ago, when, owing to the introduction of high pressure gas lighting, doubts began to arise as to the permanent efficiency of lead joints. It became necessary, therefore, to find a thoroughly sound and permanent joint strong enough to withstand the increasing stresses due to the development of modern road traffic. The demand has been met by Stewarts' patent long sleeve welded joint, by which lengths of pipe are welded together, *in situ*, into one continuous main. This joint has been adopted by Birmingham, Newcastle, Birkenhead, and dozens of less populous districts.

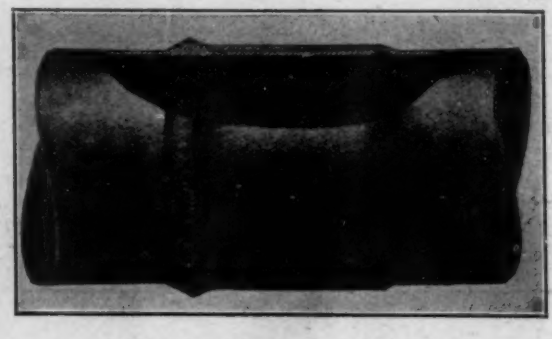

Fig. 1.

The standard joint consists of a slightly tapered spigot end which is a driving fit into a correspondingly tapered socket, the latter having a slightly belled mouth on which the weld is made. The close fit of the two tapered surface relieves the weld of transverse bending stresses. The bell mouth facilitates the entry of the spigot end of one pipe into the socket end of the next, and gives a long contact surface for the weld.

In districts, where few cross pipes are encountered in the trenches, it is most convenient to make the joints above ground on trestles, shifting the trestles forward as each joint is completed, and allowing the finished pipe line to settle down into the trench by its own weight.

For pipe 8 inches in diameter, and in populous districts this cannot be done, and therefore some or all of the joints must be made in the trenches and without turning the pipe; and to do so a bell hole about 6 feet long 12 to 15 inches deep under the pipe must be provided for the welder at each joint.

In many cases it is practicable to weld-up from 6 to 12 pipes without having bell holes, the pipe being turned round in the trench and welder. The next joint is then placed in position, but left unwelded,

1. *Journal of Gas Lighting.*

Fig. 2.

and another length of 6 to 12 pipe welded up. The operator then returns and joins up the two long lengths by welding in the ditch.

Fig. 3.

It is generally agreed among gas engineers that the maximum variation of temperature to which gas mains in this country are liable is well under 20° F., and a long, straight pipe welded into a single length and rigidly held longitudinally and transversly will be stressed to the extent of 1 ton per square inch of pipe section for every 10° variation in temperature. Tests of this welded joint show a tensile strength of over 20 tons per square inch of pipe section; so that no apprehension should be felt.

To test the joint under vibration, two 20-feet lengths, set horizontally and welded together, were vibrated by means of an eccentric with a 6-inch lift, 300 times per hour night and day for three weeks, and the joint was absolutely sound and tight at 100 pounds pressure.

A notable advantage of welded joints is that, even should any slight leakage develop after the joints are finished, they can be made good by caulking, as the material in the weld is best quality charcoal iron, and, therefore, highly suitable for such treatment.

Welded joints have been used for oil pipe-lines laid under water, paid out like a cable from a barge as the joints were made, or welded-up on the bank and drawn across a river a mile wide in one length.

They have also been used for pump lines in vertical shafts, welded together in the shaft, or on the pit-head and let down as each joint was completed. The tensile stress on the joint due to the weight of a vertical pipe 1,000 feet long, is about 1½ tons per square inch of pipe section, and the joints have been found on test to bear fifteen times this stress.

There appears to be only one objection to the welded joint—that in cases where alterations may be frequently required it is not easily disconnected. In this respect, however, it is no more difficul to deal with than screw joints.

The welding of the joints is effected with a portable acetylene plant and bottled oxygen. The outfit costing about $150, and oxygen may be got in 100 cubic feet bottles, at about one cent per cubic foot.

The plant affords the handiest possible means of cutting a piece out of a steel pipe. A branch pipe may be welded-on, or a tee with welded joints inserted, or any other alteration conveniently effected at a cost probably not greater than that of melting out a lead joint.

Mr. Hewitt's Instructions for Reading Meters.

In January *Gas News*, the monthly bulletin of the Consumers' Gas Company, of Toronto, Canada, is the following explicit direction for meter reading. They attempt to go a little farther than most companies in telling the consumer how the gas makes the hands go round; and in trying to show him that if his meter is over-read, next month's bill will automatically give him credit for the excess charge. This latter we think a very good thing to include in instructions for your customers.

"A Little More Information on Meter Reading."

On page 5 of this issue of *Gas News* you will find a very interesting chart showing 21 different readings of the dials on gas meters. The 21 complete dials really represent, as it were, the travels of a single dial during the first round of the meter, from 000 or zero, all the way up to the 100,000 mark.

The working parts of a meter are difficult to describe intelligently; but it may be stated that the measuring part is constructed somewhat like a concertina bellows, moving backwards and forwards, giving a certain portion of a cubic foot of gas at a stroke. These strokes are counted and recorded in the index. The first, or right-hand dial, records 100, the second 1,000 and the third 10,000 cubic feet. These dials are plainly in view on the outside, always observable to any one taking the trouble to look at them.

When a meter is new all these hands stand at "O" when "set" in the house and connected. The moment a burner is lighted all begin to work. When the right hand dial, on which is indicated 100 of feet, has made one revolution (which is 1,000 feet), the position of the hand in the next or middle dial will have recorded it by having moved on one figure. When the hand on the middle dial has made one complete revolution (which will be 10,000 feet), it will likewise be recorded by the pointer on the third dial advancing one figure. For example, see above chart.

Dial "A" reads "3" because the index has not yet reached four. Dial "B" reads "8" for a like reason, and dial "C" reads "9." Put down these three figures, namely, "389," and add two ciphers, because the figure on the right hand dial represents hundreds. Thus you have 38,900 cubic feet as the present reading. Deduct from this the largest number on previous gas bill, say 36,900, and you have the number of cubic feet you must now pay for, or 2,000 Multiply this number by the price per 1,000 cublic feet and you obtain the proper amount of your gas bill.

Now, suppose there had been an error in making the second reading and that 39,900 instead of 38,900 had been written down, with gas at 70 cents per 1,000, your bill would have been $2.10 instead of $1.40. During the next month you consume 2,000 again, the meter reads 40,900, but to ascertain the quantity consumed we deduct the previous reading, 39,900, and it shows a consumption of only 1,000, and your bill will be made out for 70 cents, though the quantity consumed would amount to $1.40. It is thus that the much abused machine corrects the errors of fallible men.

New Methods and Appliances.

LAYING 48-INCH MAIN ON A NARROW TRESTLE.—An example of pipe-laying under difficulties is that of the 48-inch main across a swamp in Long Island City, from Bridge street to Webster avenue for the Consolidated Gas Company by the Thomas Crimmins Contracting Company of New York city.

Fig. 1.

In order to have the pipe at the correct grade and location for the future street, a timber trestle was built, consisting of bents of two piles each, spaced 6 feet c. to c., braced transversly and longitudinally with diagonal braces. The piles were capped with 8 by 8 by 6-foot timbers, on which the pipe was laid, held in place by oak wedges nailed to the caps. The pipe was all taken on at one end of the trestle, rolled over on the 45 pound traveler rails, placed across the caps the whole length of the trestle and laid from the other end.

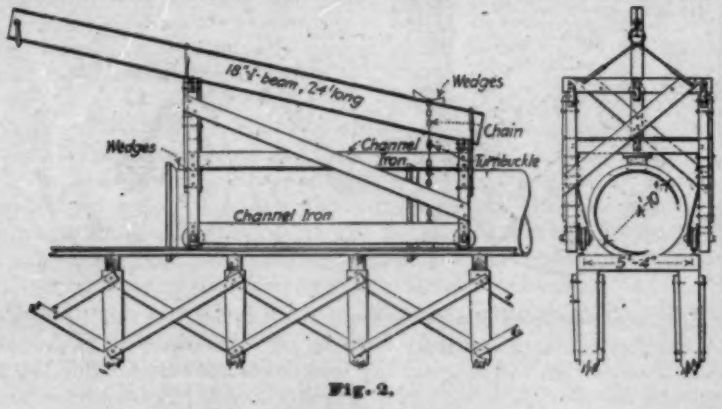

Fig. 2.

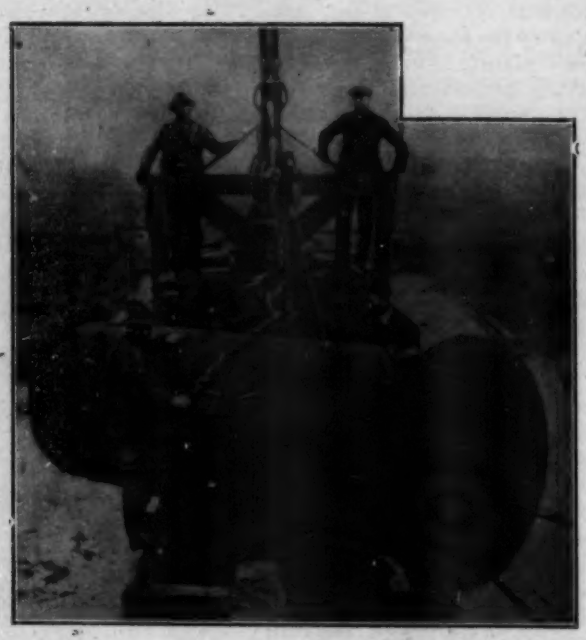

Fig. 3.

Fig. 2 is the traveler built to handle the 12-foot lengths of pipe, weighing about 8,400 pounds each. It was 24 feet long, built of 6 by 6 timbers, with 2 by 8 braces, and an iron frame carrying four 12-inch, double-flange, cast iron wheels. The boom was an 18-inch, I-beam, overhanging about 9 feet. A ten-ton chain block was on the lifting end of the boom, and the last pipe laid was used as a counterweight, by passing a chain over the boom and under the pipe, taking up the slack with a turn buckle.

The pipe was handled as shown in Fig. 3, six men and a foreman placing 25 to 30 lengths a day. The joints were made up by the gas company, using lead wool and pneumatic caulking hammers.

NEW MEDIUM FOR POWER GENERATION.—Mr. W. L. R. Emmet, Consulting Engineer to the General Electric Company, is experimenting with turbines, using mercury vapor in place of steam. It is said that be believes that by its use the capacity of existing power plants can be increased as much as 65 per cent., with a gain of 40 per cent. in output per pound of coal. The mercury is vaporized at 677° F. in a boiler of special design, from which it passes, at a little above atmospheric pressure, to the nozzles of the turbine. Upon leaving the turbine it goes to a condenser and its heat is imparted to water from which the steam can be used for other power purposes. The condensed mercury is then returned to the vaporizer by gravity and the cycle repeated. The scheme gives steam power as a by-product of the turbine.

Items of Interest
FROM VARIOUS LOCALITIES.

THE Stacey Manufacturing Company, Cincinnati, O., has closed a contract for a 200,000 cubic feet capacity, double lift gasholder, to rest in steel tank, for Stamford, Conn.; also a double lift, 100,000 cubic feet capacity for Monroe, Mich. The latter is also to rest in steel tank. Both vessels are to be erected early this spring.

MR. D. ARTHUR BARNES, since 1909, Manager, the Columbus (Ind) Gas Company, has resigned to take up the management of the Winston-Salem (N. C.) Gas Company. Mr. Glenn R. Davis, formerly a construction engineer for the named plants, goes to Columbus. Both Companies are members of the W. E. Moss & Co., syndicate.

MR. HAROLD ALMERT, C. E., for the past 5 years Manager, Department Examinations and Reports, the Messrs. H. M. Byllesby & Co., has engaged in consulting engineering practice on his own account, with offices in "The Rookery," 209 South La Salle street, Chicago. Mr. Almert is completing his 20th year of active work in the organization, financing, designing, constructing, operating and managing of public utilities, and, for several years past, has valued or passed on investments for new projects, consolidations, reorganizations, etc. Mr. Almert has practiced before many of the Public Service Commissions, has served as arbitrator in several condemnation proceedings, along which lines he is particularly well-posted in that he combines legal training with accounting, both backed by technical training and experience. As assistants Mr. Almert will have associated with him a staff of well-tutored assistants in gas, electrical, mechanical and hydraulic engineering.

"W. R. V.," writing from Charleston, S. C., under date of January 28th, says that the proprietors of the Anderson (S. C.) Gas Company are proposing to extend their service to Belton, Williamston and Pelzer, busy settlements respectively 10, 16 and 18 miles distant. It is estimated that the total cost of the proposed improvements will be not much under $150,000, and it is further worthy of note that the betterment list includes an additional storage holder.

AT a special meeting of the Directors of the Lynn (Mass.) Gas and Electric Company, this action was taken respecting the Company's late Vice-President and General Manager, Charles Florence Prichard:

"Born in Marblehead in 1856, educated in the public schools and graduated from the Institute of Technology, he soon became a leader in his chosen profession.

"He came to this Company in 1883, and has been largely instrumental in its development, its subsequent growth and efficiency.

"His complete knowledge of the industry for which he has practically given his life, made him a most valuable man, and in his profession he had few, if any, superiors.

"In his everyday life, he was a man of sympathetic tendencies and cheery disposition, and a most companionable associate, who will be greatly missed from our ranks.

"*Resolved*, That this Board tenders to his wife and children most sincere sympathy in their great affliction."

A LINE or two from the only "Peffly," Buenos Aires, January 4th last, informs us that there is much to be done in South America along gas appliance trading, especially in Brazil. He avers that American goods are in especial favor and strong demand.

THE Stevens' Engineering Society extends a general invitation to the gas men (and their women folks as well) to share in an illustrated lecture on that most versatile man, Leonardo da Vinci, whose fame as a Mechanical Engineer was equalled by his wonderful powers as an artist. In fact, as the card of invitation reads. * * * "His genius, probably the most universal of any man who ever lived, was equally well-apportioned among the three great powers, so seldom confined in one life: First, that of shaping the artistic; second, the mechanical or contriving; the reasoning or philosophical." The lecturer, who is none other than the justly celebrated John W. Lieb, Jr., who graduated from Stevens, in the Class of '80, or virtually the very year that witnessed the successful completion of the Edison incandescent electric lamp, will be the lecturer. He surely is qualified to speak understandingly on the great theme chosen by him; for, in addition to his intimate knowledge of mechanics, as a "business electrician," so to write, none excels him. Again, Mr. Lieb brings to his subject the knowledge acquired by him, during a stay of 10 years in the country of the great da Vinci. He made a special study of the life of the latter, his researches in respect to this having enabled him to "Make a notable collection of manuscripts, drawings and books relating to da Vinci's life and work." The lecture, to be freely illustrated by slides, will be delivered in the Auditorium of Stevens' Institute, Castle Point, Hoboken, N. J., at 8:15, the 20th inst.

THE Municipal Lighting Board, Wakefield, Mass., has ordered that the new rates for gas and electric current shall become operative on all quantities supplied from the first prox. Gas is to cost $1.20, net—a reduction of 10 cents per 1,000; electric current is to cost 12 cents per kw. hour, instead of 15 cents. This municipal enterprise enjoyed unusual prosperity in 1913; for, in addition to paying all current expenses, back accounts for renewals, etc., amounting to $7,100, were settled.

A SETTLEMENT of the gas rate contention in Utica, N. Y., seems in sight. In any event, Francis F. Budd, who represented "the citizens" in the contention, has agreed to a stipulation with the Company under which these charges will be operative: Per 1,000, gross, $1.20, net $1.10; to become effective July 1, 1914; July 1, 1915, the gross is to rule at $1.10, net $1.00; further, a minimum charge of 50 cents per meter per month is to obtain forthwith. This proposition or stipulation, however, must receive the sanction of the Public Service Commission, Second District.

IT is said that the Gratiot County (Mich.) Gas Company had secured (up to January 29th) 786 pledges from prospective gas users in Alma alone. Under the conditions it is asserted that work on the distributing system will be commenced in March.

"L. M. M.," writing from Danville, Va., under date of the 30th ult., says: "If the amendment to the Danville charter, that is being exploited by one Berryman Green (who is not a dealer in fruits), who represents Danville in the State Legislature, goes through, the superintendent of the Municipal Water, Gas and Light Department, will be elected by the voters, instead of being appointed by the controllers of the Department. There is little doubt that the Berryman proposition is altogether a personal one, in that the present Superintendent (Mr. Frank Talbott) was a strong opposer to Berryman's election to the Legislature. He could not uncover anything detrimental to Talbott respecting the latter's management of the named departments, hence the legislative move. I am a taxpayer in this city, and I unqualifiedly assert that Mr. Talbott is in every best sense fitted for the position he holds; further, that he completely possesses the confidence of every person here who is concerned in the growth of this enterprising community."

ON January 28th, the Directors of the Dover (Del.) Gas Light Company voted to reduce the gross rate to $1.25 per 1,000 cubic feet, the usual discount of 10 per cent. to go with all bills settled on or before the 15th of each month. The gas rate history of "Old Dover" is a rather remarkable one. The plant went into commission in 1867, and the rate charged was $16 per 1,000. In 1873 (when the Richardsons secured control) the works were rebuilt, and the selling rate was cut to $5 per 1,000. Now, as our informant writes, "Dollar gas is practically in sight." The Company has determined to extend its distributing system to and through the outlying districts of Camden and Wyoming, both of which settlements are growing rapidly.

THE Milwaukee Gas Company's tax contributed this year to the city's treasury totalled $216,377.96. The Company's taxes on County account amount to many thousands in addition.

MR. FRED. J. REYNOLDS, formerly of Quincy, Ills., and who assumed the Superintendency of the plant of the Hillsboro (Ills.) Company the last week in January, reports a brisk trade in the placing of gas ranges, water heaters and the like.

MR. D. P. SHERER, of Philadelphia, has succeeded Mr. T. M. Rive, of Cape May, as Manager of the local branch, the Carbondale (Pa.) Gas Company.

AT the annual meeting of the Detroit (Mich.) City Gas Company, Mr. Alonzo P. Ewing was elected to the Directorate, and Mr. Victor F. Dewey was promoted to the position of First Vice President. The complete organization of the Board is as follows: President, Emerson McMillin; First Vice-President and General Manager, Irvin Butterworth; Treasurer and Secretary, Charles S. Ritter; Assistant General Manager, Alonzo P. Ewing; Auditor, H. W. Sheriffs; Assistant Treasurer, J. M. Wright.

ON the evening of the second instant, Mr. George W. Harris, who has severed his connection as Superintendent of the street railway division of the Birmingham (Ala.) Railway, Light and Power Company, was presented with a beautiful silver service by his former employees. The presentation speech was made by Mr. Hugh Marrow, Counsel to the Company, and the astonished recipient did the best he could in accepting this testimonial from the rank and file, amongst whom he had no favorites. Merit, worth and loyalty were the hallmarks of his recognition.

"L. M. R." is informed that the Ohio Public Service Commission recently set aside an ordinance, adopted by the Toledo (Ohio) City Council, which directed the Toledo Railways and Light Company to cut its selling rate for artificial gas to 70 cents per 1,000. The Company had been charging 90 cents, and that rate is restored by the decision.

MR. W. R. RUSSELL has resigned the position of Superintendent of the works, the Springfield, (Ills.) Gas Company, in order to manage the plant of the Emporia (Kas.) Company. Mr. George Dawson is temporarily in charge at Springfield.

AT the shareholderss' meeting, the Equitable Illuminating Gas Light Company, Philadelphia, the only change was the substitution of Mr. Paul Thompson on the Board, vice Mr. W. F. Douthirt.

"PASTEL," writing from Edwardsville, Ills., under date of the 28th ult., says: "That the Edwardsville Company is not color-blind would seem a positive fact from these illustrations: Its General Superintendent is Mr. White; the plant manager is Mr. Black; and the office man is Mr. Schwarz. A sort of silhouette, d'ye see?"

THE plant and other possessions of the Antigo (Wis.) Gas Company, which were sold under foreclosure proceedings the morning of the 27th ult., were purchased by Mr. W. G. Maxcy, owner of the Antigo water works plant, at his bid of $21,000. This sum exactly represents the mortgage indebtedness, thus made up: Mortgage for $20,000, held by Messrs. R. H. Hackett and Louis Schrieber, as Trustees, and a second mortgage of $1,000, held by the Farmers' Bank, of Omro.

IN the turnover of the properties of the Fairmont Gas Company, of Fairmont, West Va., which was recently transferred to a syndicate, headed by Mr. Jere. H. Wheelright, of Baltimore, Md., Mr. Howard Bruce, of the Bartlett-Hayward Company (Baltimore) was elected to the succeeding Directorate.

THE Tracy Development Company, of Waterloo, N. Y., which corporation some time acquired title to the principal water rights in and about Waterloo, has granted a 50-year lease to the Empire Gas and Electric Company of the water rights going with the premises now owned by the latter.

Utilities Commission News.

THE Wisconsin Railroad Commission has ordered the Madison Gas and Electric Company to restore service to a consumer to whom such service has been refused on the ground that bills contracted at previous places of residence had not been paid. It was decided that service cannot be withheld from one who is willing to comply with the rules and regulations requiring the furnishing of security for the payment of current bills when due, although he may be owing the Company for past service. The Commission remarked that this rule may seem to work a hardship at times, but that it should have the effect of greater scrutiny of credits to the Company in the future and a more extensive application of the rule relating to deposits.

THE Wisconsin Railroad Commission has passed upon the application of the Waukesha Gas & Electric Company for an increase in rates and has issued a decision ordering a reduction in rates for electric service and a revision of rates for gas service.

The decision notes that the American Gas Company, which controls the property, is primarily interested in gas. Its effort has been directed toward extending the gas business and little or nothing has been done, except recently, to further the sale of electricity, with the result that the Company has one of the best developed gas businesses in the State and about the most poorly developed electric business. In commenting upon this condition of affairs, the Commission says: "Companies holding indeterminate permits, whether for single or joint utilities, have assumed the responsibility for the highest reasonable development of their business as well as for adequate distribution and sale."

The utility contended that it was entitled to a considerable amount for going value. In view of the existing conditions, the Commission held that it would be an injustice to force the consumers to bear the costs resulting from "what might be termed the neglect of the management to properly stimulate the sale of the utility's product."

The Commission held the opinion that a sche[illegible]as used as a counter- to develop increased lighting consumption would [illegible]he pipe, taking than one formulated to produce adequate returns unde[illegible] cumstances. Attention was called to the fact that the motor ser with a consumption of over 5½ times that of lighting, contributed only 9 per cent. more to the total revenues. The high rate for lighting service and the failure of the Company to push the sale of electrical energy are held responsible for the poor development.

THE Wisconsin Railroad Commission recently investigated gas rates in the city of Milwaukee. In the course of this investigation an analysis was made of the bills rendered by the company, and it appeared that about 70 per cent. of the consumers are paying less than their share of the cost of service, and that these consumers use only one-third of the gas sold. Among the larger users, 5 per cent. consume 30 per cent. of the gas.

An analysis of the costs of the service showed that there was a difference in the cost of serving various consumers, and that the cost to the smallest consumer is more than he can be required to pay. If the rates to such users were based entirely upon costs they would stop using gas. This is recognized in preparing the rate schedules by spreading the loss resulting from supplying the smallest users over a large part of the consumption.

The schedule of rates ordered by the Commission is graduated, with 5 steps from the lowest to the highest rate, and covers a range of 30 cents per 1,000 cubic feet. The highest rate applies to a consumption under 7,000 cubic feet per month; the next rate to the following 13,000 cubic feet; the third to the next 80,000 cubic feet; the fourth to the next 100,000 cubic feet, and the lowest to everything over 200,000 cubic feet.

This same principle has brought about graduated schedules of charge in the electric light and power industry. The small user is the costliest user, from the standpoint of the company, and the rates charged the large consumer—who ordinarily is a long-hour consumer—make it possible to take care of the small users at lower rates than really justified.

The Market FOR GAS SECURITIES.

A further broadening of the market was in evidence last week, in that trades were made in some local gas bond issues that have not been quoted for months. The careful buyers who, within the last twelvemonth, managed to secure some bargains in the bond line, are now reaping the reward of their keenness.

Consolidated opened to-day (Friday) at 135⅞ to 136¼, or to all intent a gain of one point in the week. As our readers know the dividend rate was not increased for the last quarter. The earnings showed 7.24 per cent. earned for the year, or a decrease of .29 per cent., as compared with the previous twelvemonth. Satisfactory arrangements have been made with regard to the note issues maturing the 25th inst.

The particularly gratifying thing in connection with the election of Trustees for the year was the continuance on the Board of Mr. George F. Baker, who it was feared would not consent to a re-election. He has been to his fellows an associate whose business views and practices are not of the vacillating sort, as some of the gentlemen prominent in the political grab bags of New York and Albany are concerned know. All hail to the celebrated pronunciamento of Mr. Samuel Sloan, made some years ago.

Brooklyn Union is much more firmly held, although the nominal quotations (126 to 128) are in no sense an index of its intrinsic worth. The Company continues to feel the benefit of its large outlays on mains' account made in the last 5 years; and contractors might do well to keep the Company well in mind about the present time. We understand that large betterments are projected, especially in respect of its Southern division.

The efforts of the minority holders in Washington (D. C.) gas did not amount to much. Their proposition to increase the Directorate from 7 members to 15, signally failed. That it was good policy to go along over the old path would seem borne out when it was known that the sum applicable to dividends (which amounted to 24 per cent. during the year) was $11,000 in excess of the like balance for 1912. Its total gross earning amounted to $2,188,479; the number of meters in use aggregated 60,049—an increase of 3,100; and the average sold per meter showed a gain of 3.27 per cent. This latter item is the one that really tells the story. The organization meeting of the Board will be held next week.

The Fall River (Mass.) shareholders sanctioned the proposed increase (1,150 shares) in capital. The existing total at par is $690,000. The Hartford City (Conn.) Company's new bond issue ($400,000, four per cent.) was taken *en bloc* by Merrill, Oldham & Co., of Boston, at their bid of 95.15. The Company's technical position improves every day.

Peoples, of Chicago, was rather on the high side during the week, with a net gain of about a point in the week—the quotation this morning was 123 to 124; and, if the average opinion of well informed investors is worth anything, Peoples will cross the 140 mark before May first.

The Laclede Company's annual report show gross for the year of $4,533,491, and the net earnings equaled 8.16 per cent. for the year, which, as President Holman quietly notes, is a good showing, considering the great advances recorded in prices for materials, including coal and oil.

The Consolidated Company, of Baltimore, is offering to its shareholders, in the proportion of 1 of new to 10 old, at par, the $1,416,000 of stock authorized by the Maryland Public Service Commission. The rights accrue from the 16th inst., and 25 per cent. payments are thus arranged: February 27, March 20, May 20 and June 20. The exercise of subscription rights expires the 27th inst.

The Pacific Gas and Electric Company has declared the regular quarterly of 1¼ per cent., payable the 16th inst., and the Columbus (O.) Gas and Fuel Company has been put upon a 4 per cent. (1 per cent. quarterly) basis, the first payment under the new order being collectible March 1st. This is equal to an increase of 100 per cent.

The combined earnings of the subsidiaries of the American Gas and Electric Company in 1913 were $2,841,599, an increase of $401,822, and the surplus after charges showed a betterment of $220,209, which is a pretty good exhibit, in that its obligations are: Common, $3,500,000; preferred, $1,661,500 (6 per cent.); bonds, collateral 5's, $6,282,000. The general situation is all in favor of the investor.

GAS STOCKS.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

115 BROADWAY, NEW YORK CITY.

FEBRUARY 9.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked*
Consolidated Gas Co.	$99,816,500	100	135⅞	136¼
Central Union Gas Co.—				
1st 5's, due 1927, J. & J.	2,500,000	1,000	101	103
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	99	101
New York & Richmond Gas				
Co. (Staten Island)	1,500,000	100	59	62
1st Mtg. Gold Bds. 5 p. ct.	1,500,000	—	98½	100½
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	103	105
Con. 5's, due 1945, J. & J.	1,500,000	—	96	100
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	100	102
The Brooklyn Union	15,000,000	1,000	126	128
1st Con. 5's, due 1948, M. & N.	15,000,000	—	103	103
Yonkers	999,650	500	180	—
Out-of-Town Companies.				
Massachusetts Gas Companies, of Boston	25,000,000	100	93¼	93¾
Preferred	25,000,000	100	98	98½
Laclede Gas Co., St. Louis	10,000,000	100	100	101
Montreal L. H. & P., Canada	9,000,000	100	224	225
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	123	124
1st Mortgage	20,100,000	1,000	102	102½
2d "	2,500,000	1,000	104	—
Pacific Gas and Electric Co.	15,500,000	—	43	43¼
United Gas Imp. Co.	55,502,960	50	170	171
Washington (D. C.) Gas Co.	1,600,000	200	440	442